






# CSC 302

## Introduction to Data Visualization

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UM-Flint

## Info

-  Zoom Office: 2509859732
-  TR 9.30–11:00AM or by appointment
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-  MSB 196
-  [csc302umf.slack.com](https://csc302umf.slack.com)

# Course Description

## Catalog Description

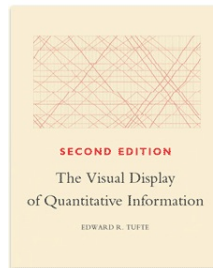
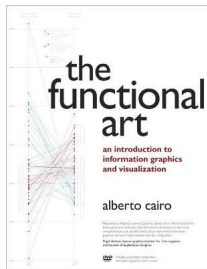
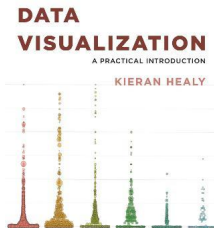
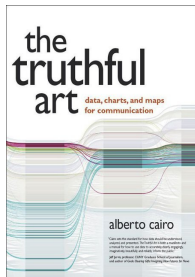
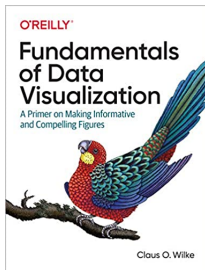
- Study of basic visualization techniques using different platforms ranging from scripting languages to off-the-shelf software packages along with necessary statistical measures. Includes an introduction to design and information literacy, fundamental data preprocessing techniques, dimension reduction, representation of time, spatial and network data, and ethical aspects in visualization. Examination of select topics in data science and machine learning.
- This class will not only introduce fundamentals of data visualizations, but also expose you several visualization tools, such as R, Python, Cytoscape, which will prepare you for any future project. Almost every class will be run like a workshop which will let you start practicing principles and methods covered on the same day. We will also cover some high-level statistical and linear algebra concepts through their applications on sample datasets which aim to broaden your vision regarding data preprocessing and manipulation steps before visualization.

# Prerequisites

## Prerequisites

CSC 122; one from SCM 211, SOC 215, SWR 270, PSY 322, PHS 347, or prior or concurrent election of MTH 370 or MTH 372; or consent of instructor.

# Books (Recommended, mostly freely available online)



## Tools

- R (<https://www.r-project.org/>),  
RStudio(<https://www.rstudio.com/>)
- Python  
([https://docs.continuum.io/anaconda/ide\\_integration](https://docs.continuum.io/anaconda/ide_integration),  
<https://www.python.org/>,  
<https://colab.research.google.com>)
- PyCharm(<https://www.jetbrains.com/pycharm/>)
- Leaflet (<https://leafletjs.com/>)
- ArcGIS ([ArcGIS.com](https://www.esri.com/en-us/arcgis))
- Cytoscape (<https://cytoscape.org/>)
- Gephi (<https://gephi.org/users/download/>)
- Tableau (<https://www.tableau.com/academic/students>,  
<https://public.tableau.com/s/>)

# Course Objectives

- 1 Understand the fundamental principles for effective data visualization.
- 2 Familiarize with available visualization tools.
- 3 Have an understanding of the distinction between good, bad, and ugly figures.
- 4 Learn why and how figures can misinform or mislead.
- 5 Know how to create a wide range of plots by using different platforms

# Student Learning Outcomes

(Based on Bloom's taxonomy of cognitive domain as marked in parenthesis after each learning outcome) You will:

- 1 understand the foundations of the visualization processes, from basic building blocks to taxonomies and frameworks (knowledge, comprehension)
- 2 understand the visualization pipeline (comprehension, synthesis, evaluation)
- 3 understand the design considerations for the components of the good visualization (synthesis)
- 4 know the methods and algorithms used to map data to graphical depictions (synthesis, application)
- 5 understand the visualization design process (knowledge, evaluation)
- 6 know a wide range of interaction techniques and styles (knowledge, comprehension, analysis)
- 7 understand the characteristics and methods that are needed for the visualization of geospatial data (knowledge, comprehension, application)



# Topics

Week	Lecture	Topics
Week 1	Lec 1	Course Overview
	Lec 2	Introduction to Data Visualization
Week 2	Lec 3	Introduction to Data Visualization (Cont.d)
	Lec 4	Mapping Data onto Aesthetics, Coordinate Systems and Axes
	Lec 5	Data Manipulation with Python
	Lec 6	
Week 3	Lec 7	Data Manipulation with R
	Lec 8	
	Lec 9	Color Scales, Directory of Visualizations
	Lec 10	Visualizing Amounts, Visualizing Distributions: Histograms And Density Plots
Week 4	Lec 11	Visualizing Many Distributions At Once Visualizing Proportions
	Lec 12	Visualizing Nested Proportions & Associations

# Topics (cont.d)

Week	Lecture	Topic
Week 5	Lec 13	Visualizing Time Series & Trends
	Lec 14	Visualizing Geospatial Data
	Lec 15	
	Lec 16	Multipanel Figures
Week 6	Lec 17	Titles, Captions, and Tables
	Lec 18	Network Visualization with Cytoscape - Gephi
	Lec 19	
	Lec 20	Tableau - An overview
Week 7	Lec 21	
	Lec 22	How to refine our Plots
	Lec 23	
	Lec 24	Understanding image formats & choosing right software Story telling with your data

# Important Dates

## Important Dates

Group formation

Dataset Due

Midterm Presentations

Final Presentations

Winter Break

Drop individual class(es) 100% refund

Drop individual class(es) no refund w/W grade

Withdraw (drop all classes) 50% refund w/W grade




# Assessment of Student Learning Outcomes

Group formation	5%
Dataset	5%
Homework	25%
In-class Assignments (ICAs*)	20%
Midterm Presentation	20%
Final Presentation	25%

\*Almost every class, we will have hands-on practices or discussion threads and some of them will be asked to be submitted as your ICA. While regular homework assignments will be graded based on the quality of the work, ICAs will be granted 100 points upon submission even if they're incomplete.

# Grading Scale

A+	97-100	C+	78-79
A	92-96	C	72-77
A-	90-91	C-	70-71
B+	88-89	D+	68-69
B	82-87	D	60-67
B-	80-81	E	0-59

 Grading may be curved if the class performance warrants it. Curving can only improve grades from the grading scale above

## Homework Remarks

- These are individual home works, and not group assignments. Although you are allowed and even encouraged to discuss the general concepts behind the home works and even outline of solutions with your classmates, multiple students **MUST NOT** work out one answer, and then submit this answer.
- I will accept late assignments. However, late assignments carry with them a 10% reduction in the grade, per week.
- All assignments must be turned in by two calendar weeks of their due date or you will receive a zero (0) grade for the assignment.
- Please note that if you are unable to turn an assignment in on the due date, then it will be considered late unless you have made arrangements with me at least twenty-four (24) hours before the assignment is due.
- Only submission via Canvas will be accepted.
- Some of the homework assignments may have to be demonstrated.

- The project has two milestones as indicated in the schedule. Both milestones require a Power Point presentation for which contribution of each member should be clear.
- While **midterm presentations** should have at least four different plots to describe the dataset and variables with your conclusions and inferences, final presentations should have more extensive visualizations with the new techniques and tools introduced.
- You can use different datasets for your your midterm and final presentations. Furthermore, you can use multiple datasets for the same topic to integrate and tell a story.

# Project Presentations-What is expected?

- ① You should organize each presentation to tell a story with the figures in it. This criterion will carry more weight for the final presentation.
- ② Figures and their titles. Please make sure you use at least **four types of figures**, e.g., bar plot, scatter plot, etc. for the midterm and **12 figures (at least four types)** for the final by using every tool introduced so far. If your dataset doesn't have spatial and network data, you're not required to use Cytoscape and spatial data visualization tools.
- ③ Reasons to generate those figures. What was your purpose and why do you think these figures will capture the information you want to convey.
- ④ Your inferences for every figure. For instance, you can say "We observe a positive correlation between height and weight. As height increases, weight also increases according to the figure"
- ⑤ Your conclusions after presenting all visualizations.
- ⑥ Please see the syllabus for the deadlines.



# Data Repositories

Here are some resources where you can find sample data sets and research problems:

- 1 Kaggle repository:  
<https://www.kaggle.com/>
- 2 UC Irvine Machine Learning Repository:  
<http://archive.ics.uci.edu/ml/index.php>
- 3 National Consortium for the Study of Terrorism and Responses to Terrorism:  
<http://start.umd.edu/data-and-tools/start-datasets>

- Intellectual integrity is the most fundamental value of an academic community. Students and faculty alike are expected to uphold the highest standards of honesty and integrity in their scholarship. No departure from the highest standards of intellectual integrity, whether by cheating, plagiarism, fabrication, falsification, or aiding and abetting dishonesty by another person, can be tolerated in a community of scholars. Such transgressions may result in action ranging from reduced grade or failure of a course, to expulsion from the University or revocation of degree.
- It is the responsibility of all students and faculty to know the policies on academic integrity in the instructional units at the University of Michigan-Flint. Information about these policies and the appeals process is available from the appropriate administrative office of the instructional units. Departments and programs within these instructional units may have specific policies and procedures which further delineate academic integrity.

# Procedural Rights of the Accused Student



A student who is charged with academic dishonesty by an instructor, administrator, or another student may be assured that he/she has the right to a fair hearing of the charges and the evidence, the right to question witnesses, to invite witnesses on his/her behalf, and to introduce whatever other evidence may be relevant to the charge.



# Code of Academic Conduct

The University, like all communities, functions best when its members treat one another with honesty, fairness, respect, and trust. Therefore, an individual should realize that deception for the purpose of individual gain is an offense against the members of the community. Such dishonesty includes:

- **Plagiarism**
- **Fabrication**
- **Aiding and Abetting Dishonesty**
- **Falsification of Records and Official Documents**
- **Identity Theft**
- **Misrepresentation and Other Acts of Academic Dishonesty**

*An attempt to commit an act prohibited by this code may be punished to the same extent as a completed violation.*

## Accessibility Issues

- It is my intention to support the full participation of all students in the learning process of this class. Students with disabilities that may restrict their full participation in course activities are encouraged to meet with the instructor or to contact the Office of Accessibility Services.
- The university provides individuals with disabilities reasonable accommodations to participate in educational programs, activities, and services.
- Students with disabilities requiring accommodations to participate in class activities must self-identify with Disability and Accessibility Support Services as early as possible at (810) 762-3456 or [dassflint@umich.edu](mailto:dassflint@umich.edu). The office is located in 264 University Center, inside the CAPS Office.
- Once your eligibility for an accommodation has been determined you will be issued an Accommodation Letter. Please present this letter to each faculty member in each class at the beginning of the term, or at least two weeks prior to the need for the accommodation.

# Final Reminders

There is a plethora of support services available to students from tutoring to mental health services. Many times students are unaware of the services available to them. Please check Student Success Center

The University of Michigan-Flint is committed to preventing sexual and gender-based misconduct and offering support to those who have been harmed. Sexual assault, harassment, discrimination and all forms of sexual and gender-based misconduct have no place here. For more information, or to make a report, please visit the Equity, Civil Rights and Title IX Office (ECRT) at <https://www.umflint.edu/ecrt>.

It is important for university employees and students to abide by the University of Michigan-Flint's Alcohol and Other Drugs (AOD) policy. It is your responsibility to familiarize yourself with the policy which is located here.

I reserve the right to modify course policies, the course calendar, assignment point values, and due dates. Any extenuating circumstances that hinder your participation in the course should be discussed with me as soon as those circumstances are known. Make-ups for graded activities may be arranged if an absence is caused by documented illness or personal emergency. A written explanation, including supporting documentation, must be submitted to me; if the explanation is acceptable, then an alternative to the graded activity will be arranged. Whenever possible, make-up arrangements must be completed prior to the scheduled activity.